Insecticidal Activity of *Lavandula angustifolia*

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Abstract
Oilseeds, pulses, and cereals that are kept are seriously harmed by insects. These pests are found all over the globe and result in significant financial losses. Common Palaearctic heteropteran *Pyrrhocoris apterus* produces the macropterous and brachypterous wing morphs, two different wing types. In all of its geographic range, the cereal leaf beetle, *Oulema melanopus* (L.) (Coleoptera: Chrysomelidae), is a well-known and significant pest of cereals. The volatile chemical mixtures that make up essential oils (EOs) of plants are frequently used as bioactive agents. Effective antifeedants, pesticides, oviposition inhibitors, ovicides, and repellents include EOs. The present work aimed to determine the insecticidal effects of the essential oil (EO) of *Lavandula angustifolia* (LA) against *Pyrrhocoris apterus* and *Oulema melanopus* in different concentration. The best insecticidal activity of LAEO against *P. apterus* was found in 12.5 % concentration. The greatest insecticidal activity was gained against *O. melanopus* when LAEO concentration was 50 %. An all-natural alternative to synthetic pesticides, LAEO demonstrated insecticidal properties.

Keywords: *Lavandula angustifolia* essential oil, insecticidal activity, *Pyrrhocoris apterus*, *Oulema melanopus*

1. Introduction

Insecticides remain a crucial tool for combating insect pests that pose a hazard to agriculture and serve as disease vectors [1]. Researchers are examining the role that environmentally friendly chemical and biological methods of controlling insect pests play in contemporary pest management [2].
The devastating effects of numerous pests, especially *Oulema melanopus*, pose a threat to wheat production [3]. *O. melanopus* can spread diseases, which could lead to even greater agricultural losses [3].
The *Pyrrhocoris apterus* global distribution has significantly expanded in recent years, most likely as a result of climate change and the introduction of plant and soil material with human assistance. The *P. apterus* stands out in the field thanks to its unique red and black coloring, which also serves as a warning color for possible predators [4].
Lavandula angustifolia, one of the many plants that produce essential oils, is still one of the most valuable [5]. The Lamiaceae family, which includes popular aromatic lavender plants, is native to the Mediterranean. Due to their attractive flavor and aroma, as well as their antibacterial, antifungal, insect repellant, insecticidal, and antioxidant capabilities, they are also used as food additives [6]. Moreover, they have been shown to be poisonous, grazing-resistant, and egg-repellent against a variety of insect pests. The compatibility of essential oil-based insecticides with integrated pest management programs is due to the low environmental risk of volatile essential oils and

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their little residual activity against predator, parasitoid, and pollinator populations [7–9].
The present work aimed to evaluate the toxicity effect of the essential oil of *L. angustifolia* against the *Pyrrhocoris apterus* and *Oulema melanopus* for the possibility of using this essential oil as an insecticide.

2. Materials and methods

2.1 Essential oil

Lavandula angustifolia essential oil (LAEO) was purchased from Hanus s.r.o. (Slovakia). Throughout the experiment, they were maintained in the dark at 4 °C.

2.2 Insect species for experiment

The tested insect species *Pyrrhocoris apterus*, and *Oulema melanopus* were captured in the area of Nitra, Slovakia. Individuals of each species were placed in bottles with air vents and transported to the laboratory.

2.3 Insecticidal activity

On the model organisms *Pyrrhocoris apterus*, and *Oulema melanopus*, the tested essential oil insecticidal activity was assessed. The Petri dish contained 30 members of the appropriate insect species.
In a Petri dish with a 60 mm diameter, a circle of sterile filter paper was put in the lid. To the cover was adhered a circle of sterile filter paper. Using 0.1 % polysorbate as a diluent, evaluated essential oil were made into concentrations (50, 25, 12.5, 6.25, and 3.125 %).
An appropriate concentration of 100 mL of the tested essential oil was then applied to sterile filter paper. The dishes were parafilm-sealed all the way around before being kept at room temperature for 24 hours.
A 100 mL solution of polysorbate at 0.1 % was used in the control group. The number of alive and deceased people was counted after 24 hours. The experiment was performed in triplicate.

3. Results and discussion

Due to environmental worries, and a rise in insect populations that are resistant to traditional chemicals over the past 15 years, interest in botanical insecticides has grown [10]. Natural insecticides produced from plants are known as botanical insecticides. Essential oils and plant extracts have been tested for their insecticidal properties against a variety of bugs that attack stored products. Despite the widespread knowledge that many plants have insecticidal properties, only a small number of pest control products made directly from plants are currently in use due to the difficulties in commercializing novel botanicals [10]. Currently, 1 % of the insecticide industry worldwide is made up of botanicals [11]. Different plant species essential oils are thought to be ecologically friendly pesticides because they have ovicidal, larvicidal, and repellent properties against different insect species [12].
When *L. angustifolia* suppressed *P. apterus* by less than 50 % at concentrations of 25 %, it demonstrated extremely potent insecticidal effects against the insect species. (Table 1). The insecticidal activity peaked at 3.125 %, the lowest quantity, and was 67 %. Nearly every insect in the control group passed away.

Table 1. Insecticidal activity of *Lavandula angustifolia* against *Pyrrhocoris apterus*

Concentration (%)	Number of Living Individuals	Number of Dead Individuals	Insecticidal Activity (%)
50	22	8	27
25	10	20	67
12.5	15	15	50
6.25	15	15	50
3.125	10	20	67
Control group	6	24	80

In addition, *L. angustifolia* displayed potent insecticidal activity against *O. melanopus* at doses of 50-6.25 %, where insecticidal activity exceeded 50 %. (Table 2). The insecticidal activity was 33

% at a concentration of 3.125 %, which was also quite strong. In the control group, everyone who underwent testing lived.

Due to the effectiveness of their insecticidal, and acaricidal effects, which have minimal environmental effects, the use of essential oils, and plant extracts as insect control agents have become the focus of intense research in a number of nations [13, 14]. These oils are composed of chemical mixtures that are poisonous to insects, and their toxicity manifests itself in a variety of ways, including the inhibition of enzymes, and the denaturation of proteins [15]. Numerous Mediterranean plants are known to have insecticidal, and acaricidal qualities. There are over 34 species of the genus "*Lavandula*" (Lamiaceae) of wild plants in the Mediterranean basin, and they are well-known for having insecticidal properties against various kinds of insects [16].

Table 2. Insecticidal activity of *Lavandula angustifolia* against *Oulema melanopus*

Concentration (%)	Number of Living Individuals	Number of Dead Individuals	Insecticidal Activity (%)
50	6	24	80
25	8	22	73
12.5	10	20	67
6.25	12	18	60
3.125	20	10	33
Control group	30	0	0

The *Lavandula* genus of essential oils has also demonstrated insecticidal effectiveness against a variety of insect species. *Anopheles labranchiae*, *Culex pipiens* molestus, and *Orgyia trigotephras* adults and/or larvae were significantly toxic to *Anopheles stoechas*, a species belonging to this family, when exposed to the essential oil of *L. stoechas*. It has been proposed that using the essential oils of *L. dentate* and *L. angustifolia*, two plants in the same genus that also show significant insecticidal effects against the larvae of *M. domestica* and *Chrysoma albiceps*, as a secure and reliable natural method to control these dipterans [17–22].

On some insect species, *Lavandula dentata* EO has been reported to have insecticidal activity, but no information specific to *A. gemmatalis* was discovered. The toxic effects of lavender essential oil (EO) on mature *Musca domestica* L. (Diptera: Muscidae), and *Chrysomya albiceps* Wiedemann species were investigated [22–25].

4. Conclusions

Natural compounds are receiving more attention because of the dangers of using synthetic insecticides to the ecosystem, human health, and the rise of new pest genera resistant to those types of natural compounds. In conclusion, the highest insecticidal activity of *L. angustifolia* has against *Oulema melanopus.*

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